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The effect of human impacts on the distribution of molluscs in Lunuwila Ela, Galle.

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Abstract
The world is in the midst of a biodiversity crisis. Now the rate of species extinction is faster than ever before. Many reasons are responsible for this extinction including human impacts. Among major taxonomic groups that recorded extinctions, upto 42% are molluscs. Molluscs are one of the most diverse and dominant animal groups among macro-invertebrates. As they are ecologically and economically significant group, it is important to identify threats affect on their distribution. The current study was conducted to determine the effect on human impacts on the distribution of molluscan groups in selected areas of Lunuwila Ela, Galle. The study was continued up to six months from January to June 2007. Both temporal and spatial data were recorded to determine the human impact on the distribution of molluscs. A constructed anicut across the stream was considered as a barrier and water quality parameters and molluscan community structure was studied on both sides of the anicut. Among nine water quality parameters studied, five parameters showed significant differences between two sides. Salinity levels indicated the highest variation between two sides (19.08 ppt in site B - 26.07 ppt in site A) and the lowest variation indicated by Alkalinity levels (6.5 μ $molL^{-1}$ in site B - 9.2 μ $molL^{-1}$ in site A). Five molluscan genera (*Faunus, Gangetia, Thiaria, Neritina and Ostria*) and one unidentified genus were recorded from both sides of the anicut. Among them five genera were identified from the upper side and three genera were identified from the lower side of the stream. Community structure parameters showed that there is a significant difference between two sides of the anicut of the molluscan community in this stream.

Key words: Mollusca, distribution pattern, Lunuwila Ela, Galle, Human impact, community structure

Introduction
The phylum mollusca is large assemblage of animals having diverse shapes, sizes, habits and occupy in different habitats (Rao, 1993). Based on their habitat preference, molluscs can be classified into aquatic and land communities. In marine (ocean) environment, all seven classes of mollusks can be found while freshwater mollusks include members of the Gastropoda and Bivalvia (Hunter, 1983). Gastropods are the only class of mollusks that adapted to the terrestrial environment. The biomass of the Mollusca is very important to ecosystems, for example in temperate countries lake bottoms may be covered with the small bivalves, which accounts for 80% of the biomass of benthic invertebrates (Seddon, 1986). As mollusks are primary consumers in aquatic ecosystems, and some molluscans are important to the ecosystem as parasites, molluscs are one of the most useful organisms in environmental monitoring (Boening, 1999).

However, the world is in the midst of a biodiversity crisis. Now the rate of species extinction is faster than ever before. The extinction rate of the molluscans is far higher than other taxonomic groups (IUCN, 2002). Among major taxonomic groups that recorded extinctions, upto 42% are molluscs. Molluscs are potentially at risk because of the impacts of human activities, such as introduction of exotic species, habitat loss or alteration of habitats and the pollution of water.

In Sri Lanka there is rapid development in constructing bridges, roads and other physical structures. Most of them are associated with wetlands and thus will make a considerable impact on fauna and flora in these habitats. The Lunuwila Ela is situated within the Galle municipal council and runs toward to the Wakgalmodara estuary. There is an anicut built up across the stream, which is not function properly. This leads to an accumulation of silt and benthos beside the anicut making a major impact on the benthic fauna of the stream. Therefore, this study is designed to determine the influence of the anicut on the molluscan community structure of the Lunuwila Ela, Galle.

Materials and methods

Description of the site

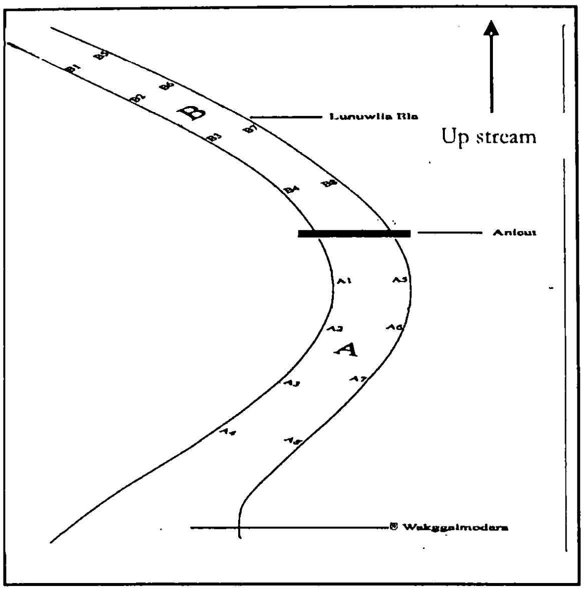
Lunuwila Ela is situated within in the Galle municipal council in Galle district. It starts from Walahanduwa area, which is approximately 16 km from Galle town and it ends with the Wakgalmodera estuary. This stream consists with mixture of saline and freshwater. Therefore, it provides excellent ecosystem with a range of environmental gradient. Both sides of the stream is covered by the mangrove vegetation, which is considered as a protected mangrove reserve and provide habitats for various types of invertebrates and vertebrates such as molluscs, insects, fishes etc.

Site selection

Two sites were selected, from each side of the anicut. Each site was consisted with eight replicates. Each replicate is covered 1 m^2 area and replicates were selected randomly. Replicates were selected from both sides of the stream. The distance between two replicates for one side is approximately 100m. The low-stream side of the anicut was labeled as site A and the up-stream side of the anicut was labeled as site B. Replicates were labeled as AI, AII---BI, BII etc. The designed sampling sites are given in the Figure 1.

Data collection

The study was continued up to six months from January to June 2007 and both temporal and spatial data were recorded. After placing quadrates at selected replicates, all visible molluscs were counted within 10 min period. Mud and sand particles were removed (upper 5 cm layer) and filtered using a sieve (2.00mm mesh size). Rocks and vegetation were thoroughly inspected for mollusks. Same person conducted sampling so that bias would be systemically applied to all sites. At the same time the molluscan species was identified. Unidentified specimens were preserved in 70% ethanol, brought to the laboratory and identified using relevant keys (Athapaththu, 1972).



1: Schematic presentation of the arrangement of the sampling sites along the Lunuwila Ela.

Temperature was measured at the site using the thermometer. Samples from the surface water were taken at each replicate for analysis of water quality parameters: Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Alkalinity, Salinity, Suspended Solids (SS) and Total Dissolved Solids (TDS) were determined using established standard protocols (Hadrian et al. 1985).

Statistical Analysis

Molluscan community structure was analyzed by means of total number of species (S), species incidence, frequency of occurrence, average density, Jaccard similarity coefficient and Shanon-Weiner diversity index (Bego et al. 1986). The levels of significant differences in abiotic and biotic parameters between two sites were determined using independent sample t-test using SPSS version 10.

Results and Discussion

This study was based on the determination of human impact on the distribution of molluscs in Lunuwila Ela, Galle. There is an anicut constructed to control water flow along this water body, which played an important role in structuring molluscan community. There was no significant variation determined within temporal data that measured for different parameters. Therefore, for a particular replicate, obtained temporal data for each parameter were added up to get a mean value. Finally, a single mean value for each parameter was calculated for each site using replicate data.

Table 1. Mean values, standard deviation and significance levels for selected water quality parameters and total molluscan individuals recorded from the site A and site B.

Parameter	Mean value(±SD)		Sig.value (t - test)
	Site A	Site B	
Chemical Oxygen Demand (COD) / mgL^{-1}	0.02± 0.01	0.03±0.01	0.049*
Biological Oxygen Demand (BOD)/ mgL^{-1}	2.61±1.22	1.54±1.25	0.000*
Dissolved Oxygen (DO) / mgL^{-1}	5.56±2.12	6.56±2.58	0.063
Salinity (SAL) / ppt	26.07±7.81	19.08±10.39	0.001*
Alkalinity (ALK) /μ $molL^{-1}$	9.20±7.90	6.50±5.30	0.086
Temperature (TEMP) / ^0C	33.10±2.86	33.40±1.71	0.603
Hardness (HARD)	0.04±0.01	0.02±0.01	0.000*
Suspended Solid (SS) / mg ml^{-1}	0.04± 0.02	0.05±0.04	0.159
Total Dissolved Solid (TDS) / mg ml^{-1}	0.02 ± 0.01	0.01± 0.01	0.026*
Total molluscan individuals (Tot)	76.93±13.12	166.28±15.14	0.008*

(Significant level < 0.05; * indicate the parameters that are significantly different between two sites)

Table 2. Species incidence and Frequency of occurrence values for each molluscs species in Site A and Site B.

Name of the genera	Species incidence		Frequency of occurrence	
-	Site A	Site B	Site A	Site B
Faunus	1	0.5	0.9502	0.01558
Gangetia	0.25	1.0	0.03980	0.9498
Thiaria	0	0.5	0	0.0066
Nerita	0	1.0	0	0.0270
Ostria	0.375	0	0.01003	0
Unknown	0	0.375	0	0.0010

Table 3. Community structure parameters calculated for the molluscan community of site A and B.

Parameters	Site A	Site B
Abundance /m^{-2}	512-812	786-2449
Number of species	03	05
Average density/m^{-2}	0.15-0.24	0.12-0.37
Shannon Wiener index/m^{-2}	0.13-2.05	0.01-0.16
Dominant genus	*Faunas*	*Gangetia*
Jaccard similarity coefficient	0.4	

Among nine environmental parameter analyzed, five of them (COD, BOD, SAL, HARD, TDS) showed significant differences between two sites. The highest variation showed in salinity (19.08ppt in site B – 26.07ppt in site A) and the lowest variation showed in Alkalinity (6.5 μ $molL^{-1}$ in site B- 9.2 μ $molL^{-1}$ in site A) (Table 01). Among significantly different parameters, site A showed higher values for four parameters except COD (Table 01). The reason for the high values of the salinity and hardness in site A might be due to the mixing of seawater. However, it seems that the construction of anicut prevents the natural flow of water along the stream, which leads to change the environmental parameters significantly in the site B.

When consider the molluscan community structure, six molluscan genera were identified from the two sites. Among them five genera were identified in site B and three were identified in site A. While genus *Ostria* was present in site A, *Thiaria, Neritina* and one unknown genera were present in site B. Genus *Faunas* and *Gangetia* were present in both sides (Table 02). While the genus *Faunas* showed the highest number of frequency of occurrence in site A, genus *Gangetia* showed the highest value for this parameter for site B. However, when the total number of replicates was considered, genus *Faunas* showed the highest incidence among other genera (Table 02). The species abundance was significantly different between two sides ($P < 0.05$). The abundance was higher in site A (about 6660 individuals) than in site B (about 3317 individuals) (Table 03). Jaccard coefficient (Sj) was applied to evaluate the similarity of the community structure of two sites. It indicates low similarity between two sites (<0.05) (Table 03). Although the mean abundance, number of species and average density is higher in site B (Table 03), it showed low diversity. According to the Shanon Weiner diversity index, Site A showed higher diversity (0.32) than site B (0.25). This difference might be due to the construction of anicut, which limits the flow of water that minimize the mixing of saline water and fresh water together. Because of this reason, site B showed very slow flow rate, which produce more, homogenized environment with minimum fluctuations of environmental factors and facilitate to live few species with high numbers. This reason may be one of the factors to show high species abundance in site B even the diversity value is low.

Aquatic habitats can be lost when wetlands are filled in for development. The alteration of waterfront for recreation, housing or commercial development can decrease the diversity of habitats available for many fauna including molluscs. Due to the diversion and damming of rivers, organic matter, nutrients and another elements as well as different pollutants are accumulated more intensively in aquatic habitats (Jurkiewicz-Karnkowska and Zbikowski 2004). The reduction of freshwater flow leads to change physiochemical parameters in a water body and directly or indirectly affect on the distribution of aquatic fauna. Lardicci *et al* (1997) discussed this matter using aquatic molluscan groups in Mediterranean lagoons. Eddy and Underhill (1974) conducted a similar study and showed that dam construction prevents the distribution of mussels in up-stream of the dam due to the limited movements of their host species in upper Mississippi valley. Finally, it can be concluded that according to the water quality and community structure data that recorded in this study, clearly indicates the construction of anict has been influenced on structuring of the molluscan community in the Lunuwila ela, Galle.

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